



Ability Analysis of Providing Explanations and Strategies in Learning Science

Lia Kartina¹, Nurmeimana², Ikechuku Abamba³, Amar J. Aswad⁴

^{1,2} Physics Education, Universitas Jambi, Jambi, Indonesia

³Departemen of Science Education, Delta State University, Nigeria

⁴Department of Physics, Tikrit University, Turkey

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ABSTRACT

Purpose of the study: This descriptive study aims to analyze science learning based on students' High Order Thinking Skills, which can be seen from the thinking skills of students in junior high schools.

Methodology: This research was conducted at Junior High School State 21 Jambi City using a mixed research method with an explanatory analysis design with two instruments instrument for the quantitative approach and interview sheets for the qualitative approach. The research subjects were 58 students of class VIII. The concept tested is material about lens refraction, divided into ten questions.

Main Findings: Five indicators tested are the ability to provide essential explanations (MPD) and strategies and tactics. After analyzing the student's answers, the average MPD skills were 2.40, and strategy and tactics were 2.48. This critical thinking skill is good because the teacher also provides space for students to be active in learning so that students often ask questions and analyze the material presented in learning science.

Novelty/Originality of this study: The novelty of this study is that analyzing HOTS-based science learning can improve students' critical thinking skills so that students can be active in asking questions and analyzing the material. With necessary thinking skills, students can be more open to differences of opinion, and students can still be objective with the sources of knowledge that they have before.

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Corresponding Author:

Lia Kartina,

Faculty of Teaching and Education, Universitas Jambi, Jambi, Indonesia

Jl. Lintas Jambi-Ma.Bulian KM. 15, Jambi, Indonesia, 36361

Email: simonkaruku386@gmail.com

1. INTRODUCTION

Education is an important thing in shaping human personality. This is because education is able to change human habits from bad things to good habits. which is caused by the direct involvement of students in building their new knowledge [1]. This new knowledge is adapted to the development of the world of education. Current educational developments require students to be able to adapt to 21st century learning. The challenges of the 21st century refer to four skill competencies that students must master, namely: critical thinking and problem solving, creativity and innovation, communication, and collaboration [2]. Learning that requires students to think critically, think creatively, and solve problems is learning that integrates higher other thinking skills (HOTS). This is because 21st century learners have different qualitative knowledge compared to the 19th and 20th centuries. Especially for science learning it is very important to apply HOTS-based learning. Because education functions to increase quality human resources [3].

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Education in the 21st century demands a learning process that is no longer passive. Where only the teacher conveys knowledge of reinforcement from the background until a theory is made [4], [5]. When it comes to the education curriculum, of course Indonesia has adopted this abd 21 education in the 2013 curriculum. In the 2013 curriculum it is very demanding that the learning process take place with a scientific approach [6]. This is because the conceptual approach applied by KTSP is learning that is no longer in accordance with current technological developments. Basically the 2013 curriculum is very natural with the 5M approach, namely asking, gathering information, associating, comparing and communicating [7]. This has been applied at every level of education in Indonesia.

Science is a compulsory subject at every level of education. Education basically must be able to bring students to arrive at HOTS thinking which consists of analyzing, evaluating and creating. However, current education is still limited to remembering, understanding and applying what is known as LOTS. This HOTS-based learning is very important in facing the 21st century education era [8]. This is because Indonesia is still in a low ranking position on PISA (The Program for International Student Assessment). This can be seen from Indonesia's achievements in 2015 which were only ranked 64th out of 69 participating countries [9]

Science is often considered as a very important part of science in the world. Because it relates to aspects of nature. But there are still many who think that science is difficult to learn [10]. This is because science uses a lot of mathematical equations, especially physics. Physics is the branch of science that is the least studied because it is difficult [11]. Most learning in physics must use mathematical equations. Actually, this mathematical equation can be learned through practical activities.

In learning, especially learning Physics, students are required to be able to apply and develop their knowledge in real life [12], [13]. The domain of Physics which is based on experiments, research, hypotheses, and thinking using a new perspective can function as a very good foundation and can lead to situations that allow to develop high order thinking skills [14]. Physics has goals including that students have the ability to master the concepts and principles of Physics and have the skills to develop knowledge, and a confident attitude as a provision to continue their education at a higher level and develop science and technology [15]. But until now physics lessons are very closely related to the category of difficult subjects. Physics is considered a difficult and frightening subject because in physics there are many mathematical equations and students think these mathematical equations must be memorized [16]. One way that educators can do is to carry out a diagnosis that aims to identify the types and causes of learning difficulties [17].

Physics is a lesson based on experimental observation so that learning is more appropriate when using experimental methods [18]. Physics learning in schools should be carried out with a scientific approach (scientific approach) so that it is more meaningful and forms the character of students [19]. Activities that involve scientific procedures can be carried out through practicum methods. In Physics education, laboratory/practicum activities are absolutely necessary because they are a support in increasing understanding of Physics concepts (Kustijono, 2011). Laboratory method has an important place in that it enables students to learn natural science concepts, which are abstract to many, more effectively and more meaningfully [20]. This practicum is generally used to verify the principles, theories, or laws being studied

Define critical thinking as analytical thinking based on rational discourse with careful and rigorous investigation and approach. States that when critical thinking is developed, a person will tend to seek the truth, think divergently (open and tolerant of new ideas), be able to analyze problems well, think systematically, full of curiosity, mature in thinking, and can think independently. This means that critical thinking skills are important and need to be nurtured from an early age, especially in elementary schools. Thinking skills can be influenced by learning methods, conventional learning methods where students have to memorize formulas will prevent students from understanding concepts [21]. So it is necessary for the teacher to provide an effective way of learning to foster students' thinking skills.

Higher other thinking skills (HOTS) are learning with various possibilities for solving various problems in natural science material [22]. In HOTS-based learning there are four components that are required, the first is critical thinking skills, the second is creative thinking skills, the third is logical thinking skills, and the fourth is the ability to provide solutions [23]. Responding to the challenges of the 21st century, especially in integrated science subjects, especially physics material so that students can understand physics concepts, it is very important to develop students' critical thinking skills. Critical thinking is an active and active discipline process of conceptualizing, applying, analyzing, systemizing, and/or evaluating information collected from observation or communication skillfully. Critical thinking is very important for every student to have. face 21st century education. The competence of students is increasingly required to have skills that continue to increase. Therefore it is very important to improve students' skills in critical thinking. Especially in science subjects such as physics, it is highly demanded that students have critical thinking skills.

Physics learning can be said to be successful if the achievement of the learning objectives is good. Formally, the objectives of learning physics in integrated science do not only emphasize cognitive aspects, but the ability of students to solve physics problems or problems can also be a measure of success in studying physics [24]. Giving students to think critically in solving physics problems is the expected output in science

education [25]. Critical thinking skills for individuals play an important role in analyzing thoughts, arguments, problems carefully based on the credibility of data and information sources; trying to give an assessment of the thoughts, arguments, problems correctly; able to solve problems logically in various situations and make decisions based on consideration of relevant evidence and facts [26].

Teaching critical thinking skills can be carried out by educators by learning using constructivist learning strategies that have the potential to empower critical thinking skills, such as project-based learning [27]. These thinking skills are closely related to the learning demanded by world education, namely learning based on higher order thinking skills or higher-order thinking skills [28]. The scope of critical thinking is: 1) understanding arguments and believing in them, 2) assessing arguments and believing in them, and 3) developing and defending arguments with strong support and full confidence [29].

Learning physics to understand the concept (refract on the lens) is still very low [30]. In addition to the students' low mastery of concepts, it is also difficult to solve problems in the field of physics. Therefore, teachers as educators are expected to be able to facilitate the development of students' cognitive abilities and critical thinking skills [31]. Based on this, it is necessary to know how students' critical thinking skills are related to the concept of refraction of the lens in science subjects in junior high schools.

2. RESEARCH METHOD

This research descriptively explains how the high-level thinking skills of Junior high school Kota Jambi students are viewed from students' critical thinking skills. Jambi City Middle School. This study used a mixed method research, namely by combining quantitative and qualitative research types. Mixed research methods is a research approach that combines qualitative research with quantitative research. Where the results of this study are descriptive which is strengthened by the statements of the respondents [32], [33]. Where is quantitative data as primary data or data that is more dominant than qualitative data [28], [34]. Where the qualitative data is described narratively. There are two variables in this study, namely the independent variable and the dependent variable. The independent variable is scientific process skills and the dependent variable is high-level thinking, namely critical thinking. It will be analyzed whether science process skills can affect students' critical thinking abilities.

The population of this study were students at selected Junior high school in Jambi City. While the research subject was class VIII Junior high school Jambi City. This subject is determined by sampling technique based on quota sampling. Sampling based on quotas is another form of sampling based on consideration. The principle is that certain characteristics are relevant, explaining the dimensions of the population. In this case the population distribution must be known [35], [36]. The quota sampling technique is carried out on the basis of a predetermined amount or quota [37]. Usually, the subjects used as research samples are easy to find, thus facilitating the data collection process. Then the chosen research subjects were as many as 58 students. The subjects of this study were class VIII students at Junior high school Kota Jambi who were undergoing learning activities in the even semester of the 2019/2020 academic year. Junior high school Kota Jambi is one of the junior high schools which is the school of choice for the community to send their children there. This is because the learning system in the SMP is in accordance with educational standards. For science subjects the teacher is sufficient so that students can study regularly.

This study uses two instruments. Instruments for quantitative research and instruments for qualitative research. For the quantitative approach, the instrument used is the test instrument. The test instrument is the suitability between the questions in the test and the indicators that have been prepared beforehand. (respondents). The test used is a written test in the form of a description which is a set of questions in the form of assignments, questions that require students to organize and state their answers in their own words [38], [39]. The description test given is about the concept of refraction in the lens adopted from [40] research regarding the development of tests of critical thinking skills in optical geometry material. The instrument for the qualitative approach is in the form of an interview sheet with teachers and students with six questions for teachers and five questions for students.

Table 1. Critical Thinking Indicators on the Description Test

Variable	Indicator	No Question Items
Critical thinking	Gives a basic explanation	1 & 2
	Build basic skills	3 & 4
	Conclude	5 & 6
	Provides input explanation	7 & 8
	Strategy and tactics	9 & 10

Data analysis technique is to use descriptive statistics. The data analysis technique was carried out using an explanatory research design. Where the quantitative data or the results of the description test were analyzed

using SPSS and then the quantitative results were strengthened by the narration of the interview results. Explanatory design analysis techniques are studies that prioritize quantitative data analysis first, then proceed with strengthening the results of quantitative data analysis by analyzing quantitative data results.

Critical thinking skills will be analyzed using intervals of critical thinking skills based on interval calculations with a Likert scale. For critical thinking skills the interval is as follows.

Table 2. Intervals and Categories of Critical Thinking Skills

Intervals	Category
1 – 1.5	Very low
1.6 – 3	Low
3.1 – 4.5	Tall
4.6 – 6	Very high

3. RESULTS AND DISCUSSION

Researchers analyzed students' critical thinking skills based on indicators. There are five indicators tested on the test for critical thinking skills this time. The first indicator is to provide a basic explanation of the problem to be solved. For this indicator, there are two essay test questions used, namely No. 1 and 2. For indicators that provide a basic explanation, the sub-indicators being analyzed are analyzing arguments in word problems. The obtained results for the indicators provide a basic explanation as follows.

Table 3. Descriptive Critical Thinking Skills Indicators Provide Basic Explanations

Indicator	Interval	Frequency	Percentage (%)	Category	Std. Deviation	0.493
Provide Basic Explanation	1.0 – 1.5	0	0	Very low	Median	2
	1.6 – 3.0	35	60.3	Low	Mean	2.4
	3.1 – 4.5	25	39.7	High	Mode	2
	4.6 – 6.0	0	0	Very High	Min	2
					Max	3

Table 3 presents the results of critical thinking skills for indicators of basic explanation skills. Out of 58 students, 60.3% or 35 students have low basic explanation skills. 39.7% or 23 students have the ability to provide high basic explanations, the rest are high. The average student has the ability to provide basic explanations on essay questions of 2.40. for the median 2.00, mode 2, the minimum value is 2 and the maximum value is 3 and the standard deviation is 0.493.

The next indicator is strategy and tactics. In this strategy and tactics indicator, there are two essay test questions, namely numbers 9 and 10. Strategies and tactics have sub-indicators that are able to provide innovation to the problems being tested. In science subjects, especially physics material, it is very important for students to have the ability to think skills, indicators of strategy and tactics, the following results are obtained.

Table 4. Descriptive Critical Thinking Skills Indicators of Strategy and Tactics

Indicator	Interval	Frequency	Percentage (%)	Category	Std. Deviation	0.504
Strategy and Tactics	1.0 – 1.5	0	0	Very low	Median	2
	1.6 – 3.0	30	51.7	Low	Mean	2.48
	3.1 – 4.5	28	48.3	High	Mode	2
	4.6 – 6.0	0	0	Very High	Min	2
					Max	3

Indicators of the ability to make strategies and tactics in the test of students' critical thinking skills description. It was found that 5.2% or 3 people had low ability for strategies and tactics. 51.7% or 30 people have low critical thinking skills and the remaining 28 students or 48.3% have very high ability to make strategies and tactics. The mean value for strategy and tactics is 2.48, the median is 2.00, and mode is 2. Meanwhile the minimum value is 2 and the maximum is 3. The standard deviation for strategy and tactics indicators is 0.504.

Education is a preparation effort made by someone to acquire skills, knowledge and habits in life. Education plays an important role in life, because with education a person is able to qualify himself properly in both the family and community environment. In this case, of course, the teacher needs to improve the way of thinking of his students. One of them is applying the constructor of critical thinking skills [41]. However, in

learning sometimes there are obstacles that hinder the implementation process [42]. Because in current learning the teacher still often uses the lecture method. This makes students more individualistic [43]. This is what happened to students of Junior High School 21 Jambi City.

Based on the results of research conducted by researchers, it is known that most students still have critical thinking skills in the low category. For the first indicator of critical thinking skills is to provide a basic explanation. Providing a basic explanation is a basic indicator that must be mastered by students. Meanwhile, based on the research results, students who have the ability to provide basic explanations are still in the low category with a percentage of 60.3% and only 39.7% of students who have high basic explanation skills. In science learning basically built on the basis of scientific products, and scientific attitudes. Natural science is a study process that is used to study objects of study, find and develop scientific products as applications, and scientific theories [44]. While the indicators that must also be mastered in critical thinking skills are strategies and tactics. Strategy and tactic indicators are very important in the process of learning sciences such as Natural Sciences. Based on the results of research students who have strategic and tactical skills due to speed up the scientific findings sought. Junior High School 21 Kota Jambi students still have low critical thinking skills for strategies and tactics. 51.7% of students still have low strategy and tactic skills. Meanwhile, only 48.3% of students had high strategic and tactical abilities.

Low critical thinking skills can be influenced by the learning environment and way of learning. Usually the conventional way of learning will indeed make students not explore their thinking abilities. While for science learning itself it is very important for students to discover new things. Actually this can be done with practical activities. Because practicum is a scientific method in learning science that helps students to be sensitive to problems [45]. This critical thinking will help students to have new solutions that are able to solve these problems [46]. So it is very important to carry out a learning process that improves students' critical thinking skills.

The critical thinking skills of Junior High School 21 Jambi City students are in the medium category. This is also supported by the results of interviews with science teachers and students. There are 6 questions asked related to students' critical thinking skills to the teacher, one of which is whether the teacher often gives students to express their opinions during the science learning process. The science subject teacher explained. Students are required to submit their opinions on the material being taught. In addition, the teacher also provides space for students to discuss with their classmates. Not unlike teachers, students at Junior High School 21 Jambi City also have a strong desire to learn science. Natural science is closer to learning science and thinking scientifically about science subjects [36]. There are 6 questions asked to students regarding critical thinking skills. Like whether science is related to everyday life and whether in science learning students are active in asking questions to the teacher about the material presented by the teacher. Most students answered that they were interested in science lessons because learning science can be related to everyday life. During class they always prepare questions that they want to ask their teachers or classmates during science lessons.

What is discussed is the result of descriptive statistical analysis and shows that critical thinking skills can be seen with two indicators that can be tested. The results of the analysis provide an illustration that the critical thinking skills of class VIII students at Junior High School 21 Jambi City are still low. The results of this study are different from the results of research by [47] where research using questionnaires shows good students' critical thinking skills. This difference is because the instruments tested are different compared to researchers who use descriptive tests. As for students who have different thinking abilities. This is due to the ability of students to absorb and understand different lessons [48]. This student's thinking ability can also be influenced by how the teacher delivers learning. So it is very important for teachers to be professional [10].

4. CONCLUSION

Based on the results of the research, it can be concluded that in HOTS learning which is required in 21st century education it is highly demanded that students have the skills to think critically. These critical thinking skills can be tested with a description test. In science learning it is very important to liven up the learning process which aims to improve students' critical thinking skills. Teachers who provide space for students to express their opinions can have a very good impact on students' critical thinking skills. In addition, active students generally have good critical thinking skills. The teacher can create an atmosphere of discussion in the science learning process so that students exchange opinions on the material being taught.

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